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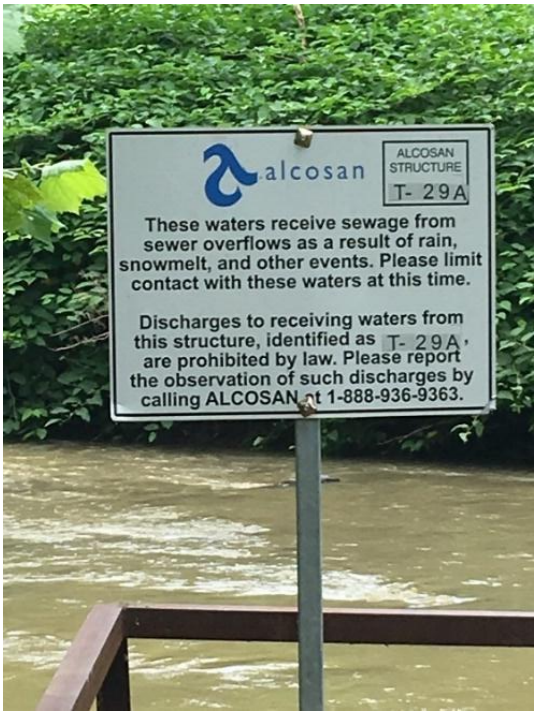
The Westmoreland Heritage Trail is a relatively new installment in the small community of Level Green in Trafford, PA. The beautiful walking trail currently runs for 8.5 miles from Saltsburg to Delmont and 9.3 miles between Trafford and Export with plans to connect the two segments. A resident of Level Green, I spent many afternoons this past summer enjoying leisurely walks on the trail, appreciating the breathtaking beauty of western Pennsylvania. Most of the trail runs alongside Turtle Creek, a tributary of the Monongahela River, which flows from Delmont to North Versailles township and empties into the river.

Westmoreland Heritage Trail at BY Pond in Trafford, PA, photo taken by Meredith Bennett, May 2019.

As someone currently studying environmental science, I had heard about combined sewer overflows in classes and knew they were common in Pittsburgh. Even so, I was surprised one day to come across a disconcerting sign that warns visitors of the potential discharge of sewage into Turtle Creek as a result of sewer overflows during heavy rains. The negative effects of combined sewer overflows are far-reaching and persistent, and the city of Pittsburgh has been confronting the problem for years. ALCOSAN, the Allegheny County Sanitary Authority, has a new plan for tackling the problem called the Clean Water Plan. The plan will incorporate a mixture of green technology and new underground pipes with the goal of solving the problem by 2036. Will it be enough?

Combined sewer overflows (CSOs) often plague old cities with aging infrastructure. In the past, engineers designed sewers to collect sewage and stormwater in the same pipes. These are called combined sewer systems. Most cities have opted for a system that collects sewage and storm runoff separately, but some areas, including Pittsburgh, are still suffering from their outdated combined sewer systems. When the weather is dry, combined sewer systems can operate just fine, but during wet

weather (something Pittsburgh is known for), the flow of combined wastewater and runoff overwhelms ALCOSAN's treatment facility and overflows at discharge sites into the river. It sounds unbelievable, but combined sewer systems are *designed* to overflow during this severe wet weather. If they were not allowed to overflow, the water would likely back up the sewage system, escaping through manhole covers and flooding buildings.



Warning from ALCOSAN that this area periodically experiences sewer overflows, photo taken by Meredith Bennett, June 2019.

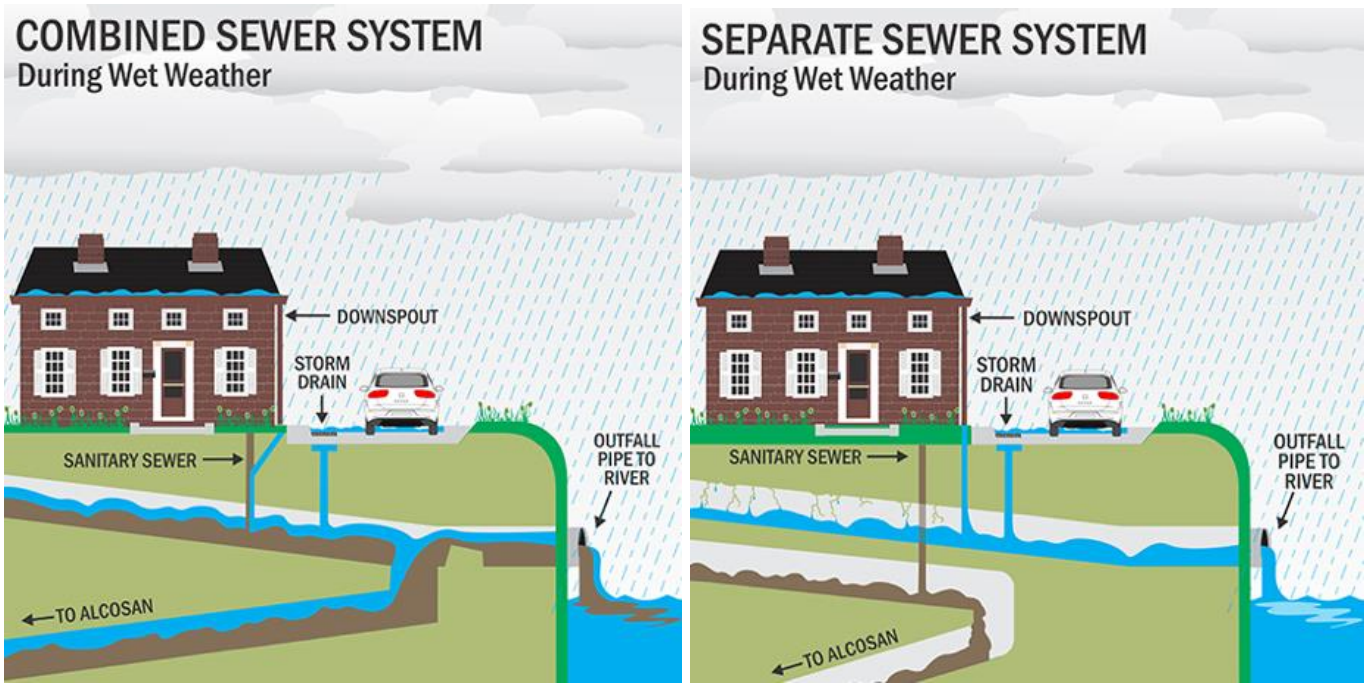


Illustration of the differences between combined sewer systems and separate sewer systems, ALCOSAN, https://3riversproud.com/, accessed Dec. 1, 2019.

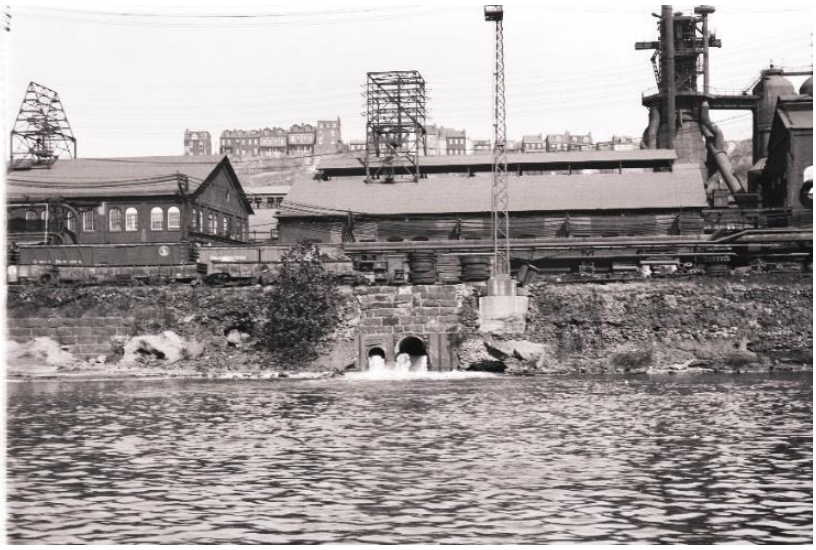
Despite the image you might have in your mind of what untreated sewage looks like, the wastewater that is discharged into the rivers from a combined sewer overflow is significantly diluted. Remember that wastewater includes not only sewage, but the water used in showers/baths, clothes washers, and sinks. In combined sewer systems, this effluent includes storm runoff as well, meaning that the rivers are receiving everything from human feces and pathogenic bacteria to pesticides and petroleum. The main pollutants in combined sewer overflows include metals, hydrocarbons, pesticides, volatile organic compounds, and chlorobenzenes. These pollutants come from the byproducts of agriculture, industrial chemicals, petroleum, paints, solvents, disinfectants, and other cleaners. None of them are safe additives to a river ecosystem or human drinking water.

Contact with raw sewage has extremely detrimental consequences for the humans who drink or swim in the contaminated water. People can even become ill from consuming fish obtained from the contaminated river. Pathogens in sewage can include bacteria, viruses, and parasites. Diseases caused by these pathogens are called waterborne diseases and they affect thousands of Americans every year. The diseases usually target the gastrointestinal system and may even result in death for vulnerable populations like children and the elderly. In 1998, in one of the stream tributaries of the Ohio River in the Pittsburgh area, researchers found combined sewer overflow discharge points to be major sources of the two pathogenic protozoa, *Giardia* and *Cryptosporidium*. Both cause gastrointestinal illness in humans. In 2004, the EPA and Pittsburgh made a cooperative effort to investigate the contribution of combined sewer overflows to cases of these gastrointestinal diseases. Combined sewer overflows were found to be a direct source of *Giardia*, but little was found about *Cryptosporidium*. In addition to the implications for human health, combined sewer overflows harm aquatic ecosystems and the wider environment. The most common pollutants in the world are actually nutrients. Although nutrients are necessary for life and healthy ecosystems, too many nutrients can be extremely damaging. Nutrient pollution occurs when livestock manure, fish feces from aquaculture, agricultural fertilizers, and of course, human sewage enter a body of water. The presence of excess nutrients is also known as eutrophication. The nutrients present in sewage are food for aquatic algae, and after a combined sewer overflow, they have a greatly increased supply of food. The excess nutrients result in a large, rapid overgrowth of algae, and they blanket the surface of the river, reducing sunlight penetration and competing with other species. These are called algal blooms, and some can even be toxic. When the algae die, they are decomposed by bacteria through the process of cellular respiration. Cellular respiration requires oxygen, and as the bacteria decompose the algae, they use up the oxygen present in the water. This condition within an environment is known as hypoxia. Without oxygen, other organisms, like fish, are unable to survive. A research group studying the Seine

Menhaden fish killed by extreme hypoxic (oxygen-depleted) conditions in Narragansett Bay in 2003, World Resources Institute, https://www.wri.org/our-work/project/eutrophication-and-hypoxia/impacts, accessed Dec. 2, 2019, photo taken by Chris Deacutis.

River in Paris argued that CSOs (combined sewer overflows) should be taken into account in water quality models given their tremendous impact on water quality.

ALCOSAN, the Allegheny County Sanitary Authority, was created to run Allegheny County's sewage treatment program in 1944, and construction on the ALCOSAN wastewater treatment plant began in 1956. Before the sanitary authority's creation, sewage and industrial waste was discharged directly into the three rivers. As you would expect, this had severe consequences for aquatic life and the citizens of Pittsburgh, so when the combined sewer system was finished in 1959, it was considered a huge improvement. As newer sanitary technology becomes available and more cities choose separate sewer systems, however, combined sewer systems have become an out of date, inferior option. Because of excess stormwater, ALCOSAN's system overflows 80 to 90 times each year and 9 to 10 billion gallons of untreated wastewater are released into the rivers every year.

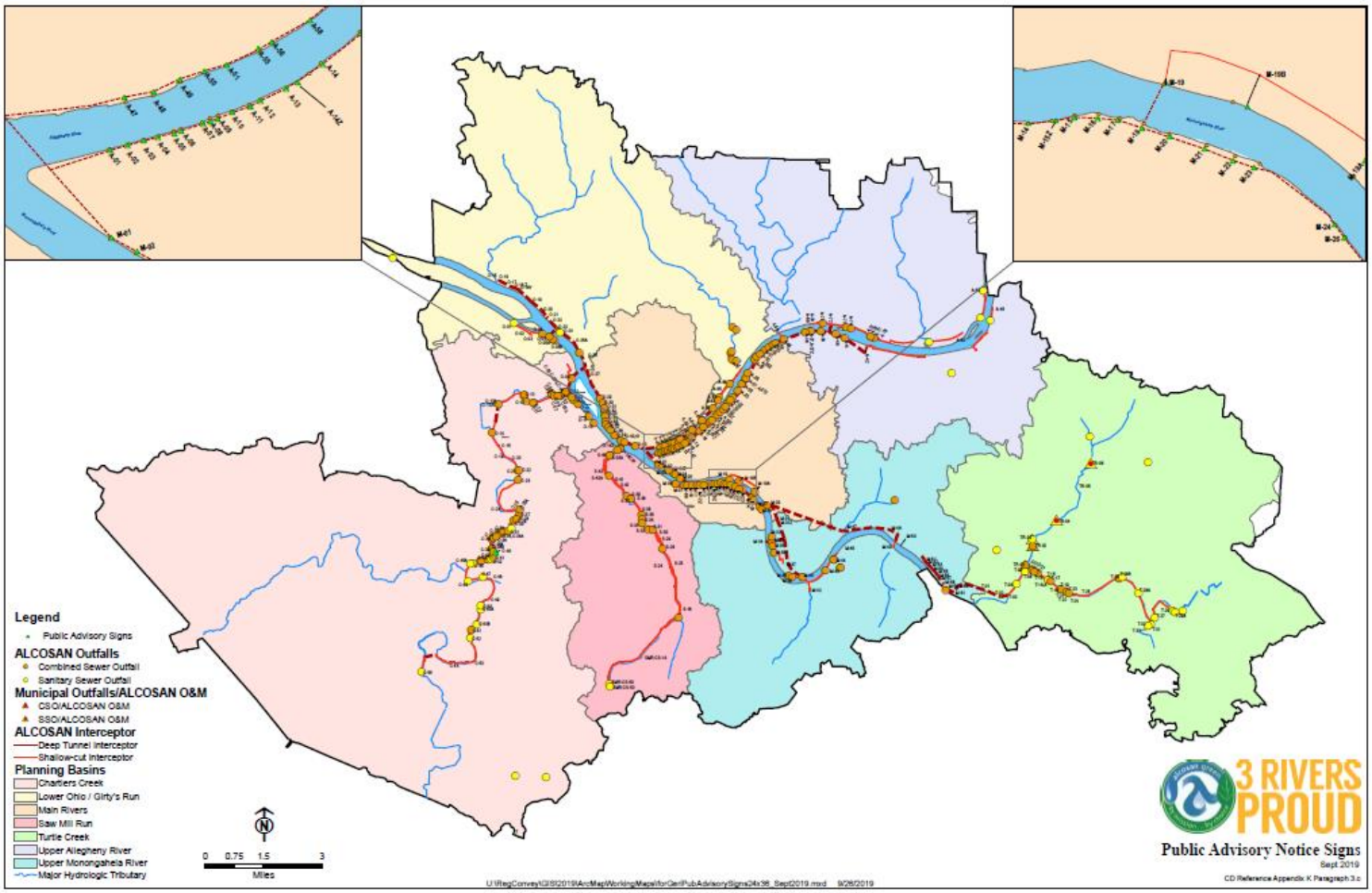


Raw sewage and industrial waste being discharged directly into Allegheny County waters, ALCOSAN, https://3riversproud.com/60years/, accessed Dec. 2, 2019.

On January 23, 2008, the EPA issued a consent decree that demanded Pittsburgh and several other cities across the country to tackle the problem of combined sewer overflows and clean up their sewer systems. Combined sewer overflows violate the United States Clean Water Act. Finally, after a delay of four years, ALCOSAN responded to this decree with its Wet Weather Plan on July 31, 2012. After a period of public commentary, the plan was submitted to the agency on January 29, 2013. The main objectives of the plan were to expand the treatment facility, creating large holding tanks and underground tunnels for the excess sewage. The Wet Weather Plan relied almost entirely on gray technology. Gray technology refers to the construction of more pipes, pumps, and holding facilities to manage excess wastewater. Green technology, on the other hand, refers to the use of nature-based solutions that generally attempt to decrease runoff in the first place, using green spaces and rain gardens to retain stormwater that may otherwise cause combined sewer overflows. Green infrastructure was given a small section in the plan, and although ALCOSAN claimed to support green technology, they explained that it was not their responsibility to control stormwater. In fact, it is their responsibility. The excess stormwater is what causes combined sewer overflows, the very problem the

EPA has ordered ALCOSAN to solve. Controlling excess stormwater is perhaps the most important part of the solution.

According to a KDKA report released after this plan, Mayor Bill Peduto was unhappy with ALCOSAN's ideas and advocated for the implementation of more green infrastructure, including green roofs, rain gardens, and rain barrels. On March 19, 2013, ALCOSAN met with the EPA to discuss a possible extension for the project in order to investigate and consider the addition of green infrastructure and flow reduction in their plan. On June 24, 2013, the EPA agreed to an extension, advising the city to get started on solutions right away.



Map of municipalities served by ALCOSAN; combined sewer overflows are represented as orange circles and triangles, ALCOSAN, http://www.alcosan.org/SewerOverflowAdvisories/tabid/177/Default.aspx, accessed Dec. 2, 2019.

On September 19, 2019, ALCOSAN released the long-awaited plan, now entitled the Clean Water Plan. The most significant change is the addition of Green Stormwater Infrastructure. Section 10 of the Clean Water Plan summarizes ALCOSAN's objectives when it comes to green technology. The new plan will integrate projects such as permeable pavement, rain gardens, and bioswales (vegetated channels that convey stormwater runoff and remove debris and contaminants). Because of the EPA's

extension, the deadline for reducing sewage overflows by 7 billion gallons is now 2036 instead of 2026. Instead of the 3.6-billion-dollar Wet Weather Plan, the Clean Water Plan is projected to cost 2 billion dollars and ALCOSAN has implemented a Clean Water Assistance fund to help citizens pay their increased bills.

Despite these improvements, many activists argue that ALCOSAN is not doing enough. They believe that the Clean Water Plan still relies too heavily on gray technology. In addition to green infrastructure, ALCOSAN still plans to increase conveyance capacity and expand the treatment plant. Activists are unhappy about this and say that ALCOSAN should adopt the "green first" approach used by the city and the Pittsburgh water and sewer authority. A "green first" approach would not eliminate the use of gray infrastructure, but it would strive to take advantage of everything green technology has to offer before using gray. This would involve decreasing the number of new underground tunnels and increasing green space instead. Many believe this is even more important now because of the increasing severity of climate change.

Photo taken of the banks of the Ohio River on a ride to PNC park, photo taken by Meredith Bennett, September 2019.

In October, members of the Sierra Club and leaders from the Nine Mile Run Watershed made a case for the "green first" approach by presenting evidence of its success in Philadelphia. Philadelphia adopted a "green first" approach in 2011 to tackle their own issues of combined sewer overflows and after ten years of its implementation, analysis shows that projects like tree trenches, rain gardens, and rain barrels work. Communities that use green infrastructure also notice other, unexpected social benefits. The planting of vegetation can benefit low income sections of communities where green space is often sparse. Because green projects are generally small and scattered, they can support local businesses and improve the local economy.

This past summer, I sat down with Dr. John Stolz, a professor in the Department of Biological Sciences and Director of CERE (Center for Environmental Research and Education) at Duquesne. His research focuses on arsenic metabolism in microbial communities and well water quality in Pennsylvania. He also has significant knowledge of the issues resulting from combined sewer overflows in Pittsburgh and has actively

involved himself in the debate surrounding ALCOSAN's response. He agreed to discuss with me his views on what ALCOSAN should do next.

Dr. Stolz mentioned two cities, using them as models for the two paths Pittsburgh might take. Washington D.C., who received the same EPA decree as ALCOSAN, opted for an "engineered approach". They created a large holding tank to capture excess wastewater, similar to the solution proposed in ALCOSAN's original Wet Weather Plan. On the other hand, Stolz argued that Philadelphia's "green first" approach used a better combination of green and gray technology. Regardless of the debate over green and gray infrastructure, Dr. Stolz emphasized the importance of replacing the sewer lines to adopt a separate sewer system which would eliminate combined sewer overflows. He recommended this be done in conjunction with replacing the water lines in the city. This will certainly require billions of dollars, but Stolz has a potential solution to the cost: a biodigester. A biodigester would use the fecal sludge created by the wastewater treatment plant to create energy. The sludge is converted to methane, which is then used to create electricity. He explains that this would offset the cost of running the plant and create a revenue stream. Dr. Stolz suggests that after 3 to 5 years of investment, this revenue could be used to fund projects like replacing the sewer lines in Pittsburgh. Excitedly, he says, "We have this opportunity to turn waste into energy. And to make money doing it". Other cities who have used biodigesters seem to be excited about their accomplishments, such as Portland, Oregon and Cleveland, Ohio. Portland currently saves 3 million dollars each year by using gas from their biodigester as fuel for heavy-duty vehicles.

The Columbia Boulevard Wastewater Treatment Plant Biodigester in Portland, Oregon. It generates 600 million cubic feet of biogas each year. The city uses the gas as fuel for medium and heavy-duty vehicles and saves 3 million dollars each year from fuel costs, The City of Portland, Oregon, https://www.portlandoregon.gov/bes/article/344953, accessed Dec. 2, 2019.

Dr. Stolz's message to students and other members of the community is to "have your voice be heard". The beginning of each ALCOSAN board meeting is open to the public in a forum that welcomes suggestions and complaints. Sustainable Pittsburgh, a nonprofit organization devoted to sustainable development, is another way to get involved in the discussion. As easy as it might be to flush our toilets and forget about what happens next, we must pay attention to where our sewage goes. If we play it right, that waste may become the electricity for a wastewater treatment plant or the fuel powering our buses. After all, poop is a renewable resource.

Combined sewer overflows are a persistent problem in Pittsburgh and in cities throughout the country. When rainfall overwhelms the city's water treatment system, raw sewage flows into the rivers, causing health problems for humans and degrading aquatic ecosystems. ALCOSAN, the Allegheny County Sanitary Authority, has opted for a plan to address overflows that incorporates a mixture of green and grey technology. Although some grey infrastructure is necessary, many environmentalists have argued that ALCOSAN should adopt a "green first" approach. By adopting green technology, we can eliminate excess stormwater instead of building more storage space for raw sewage. Moving forward, we have a chance to go all in when it comes to green technology and set the stage for other cities looking for solutions to combined sewer overflows.

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